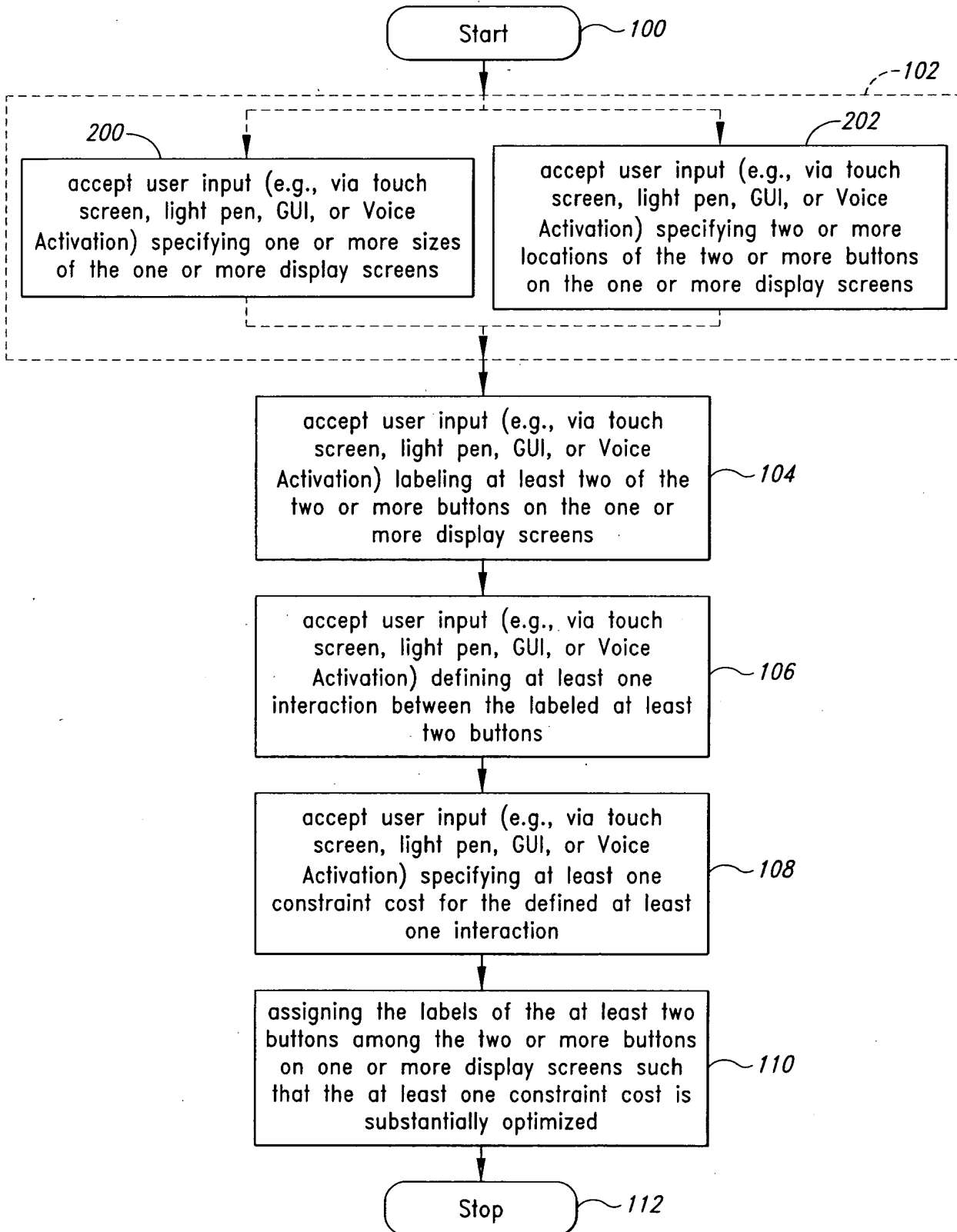
*Fig. 1*

*Fig. 2*

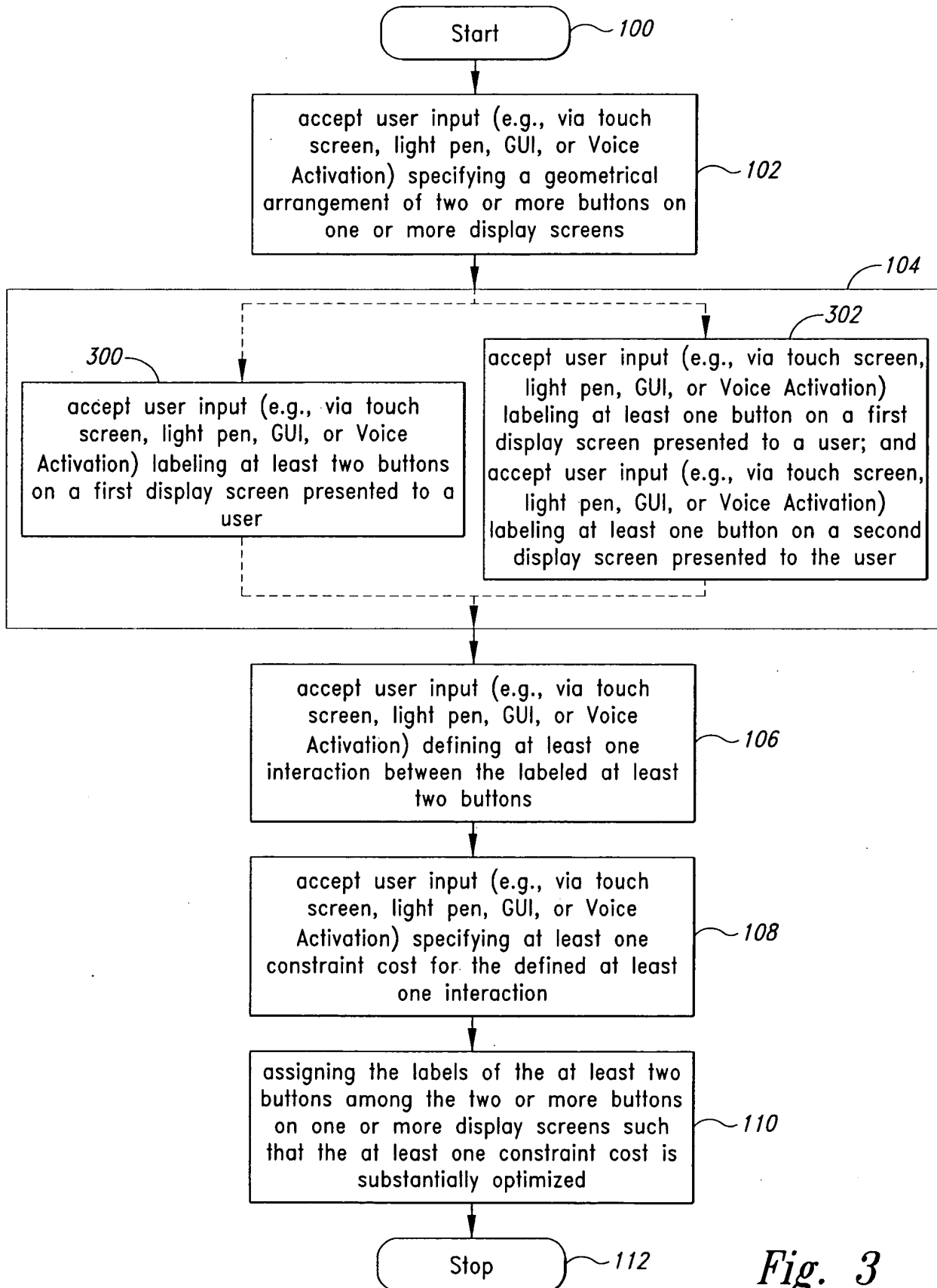
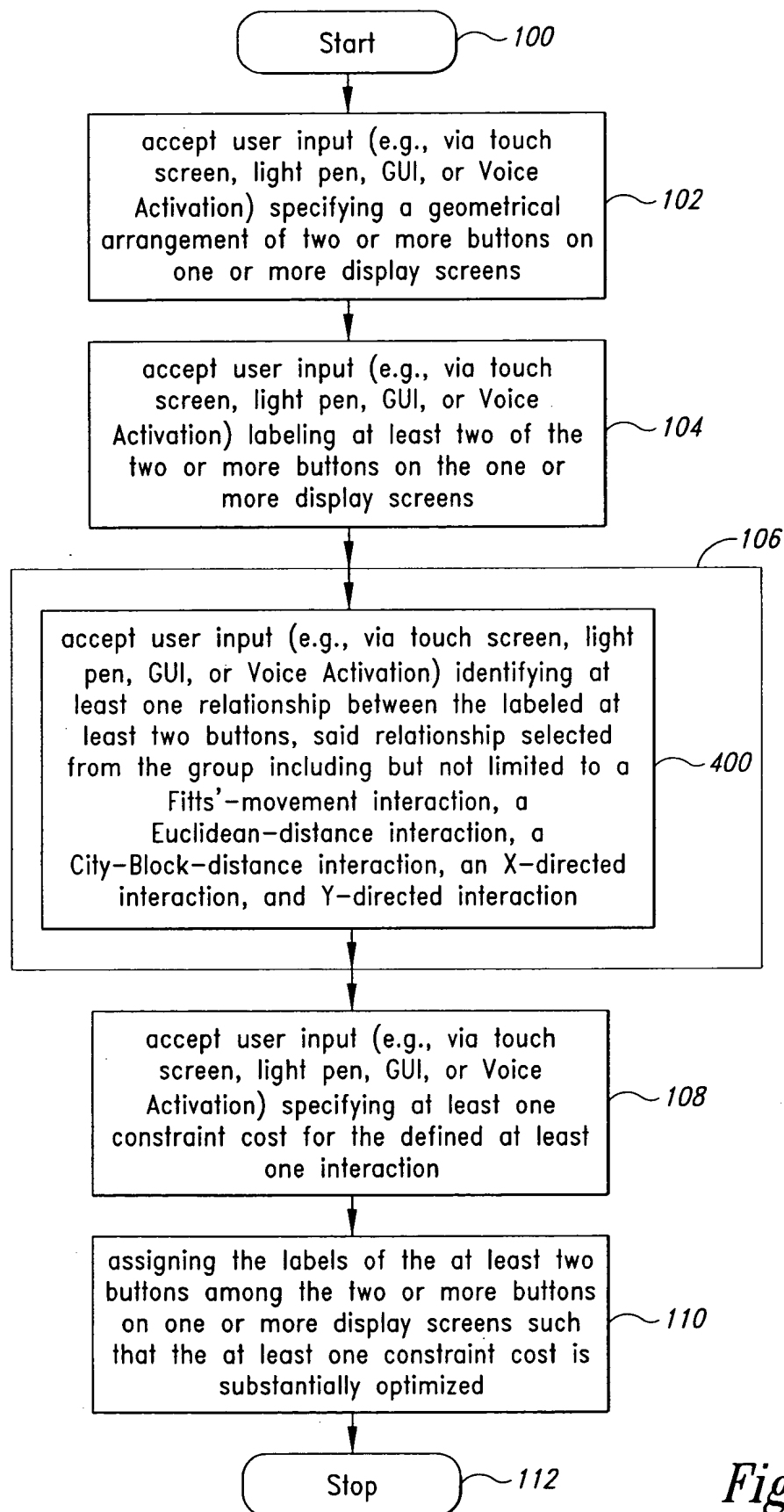
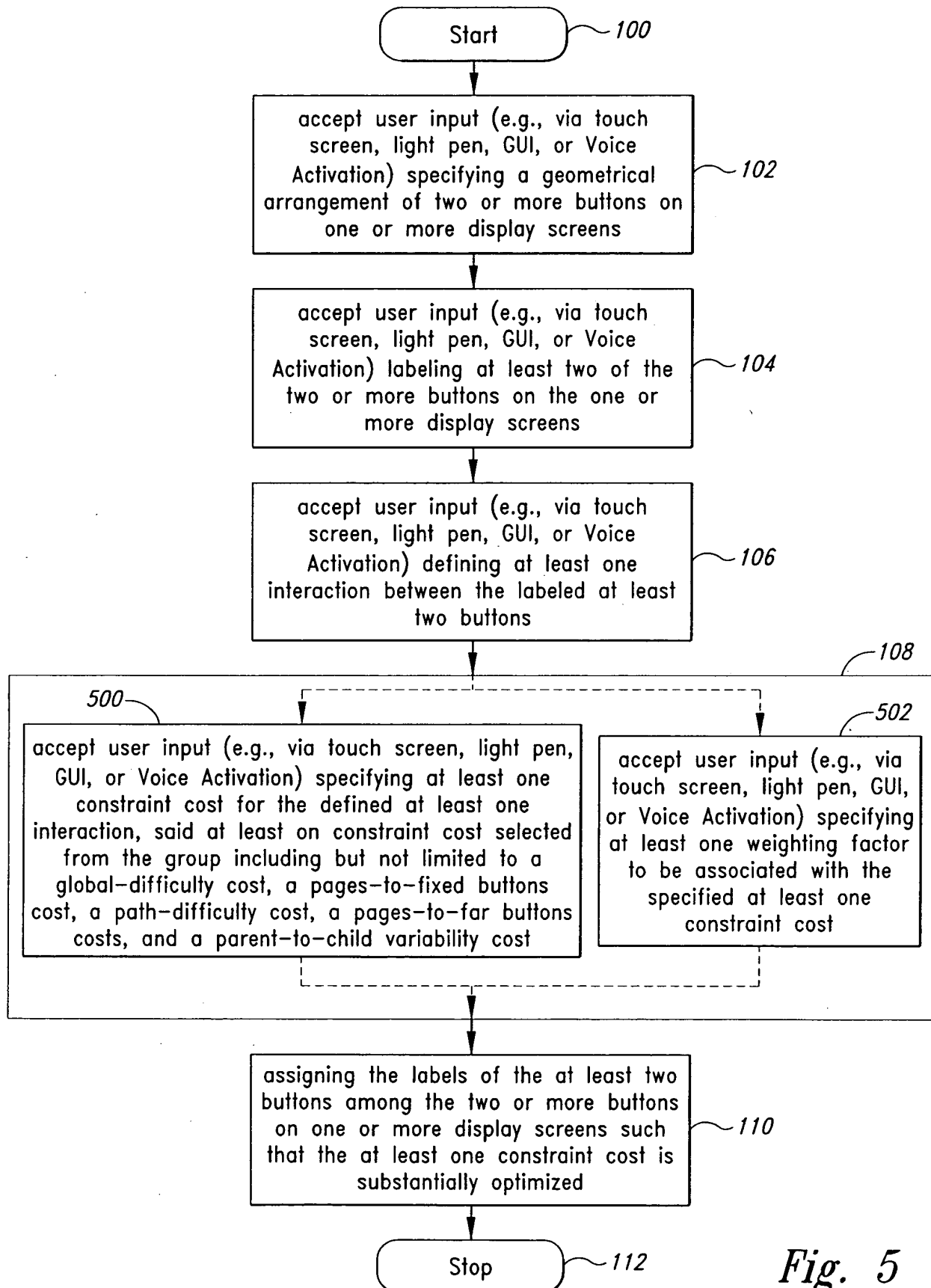
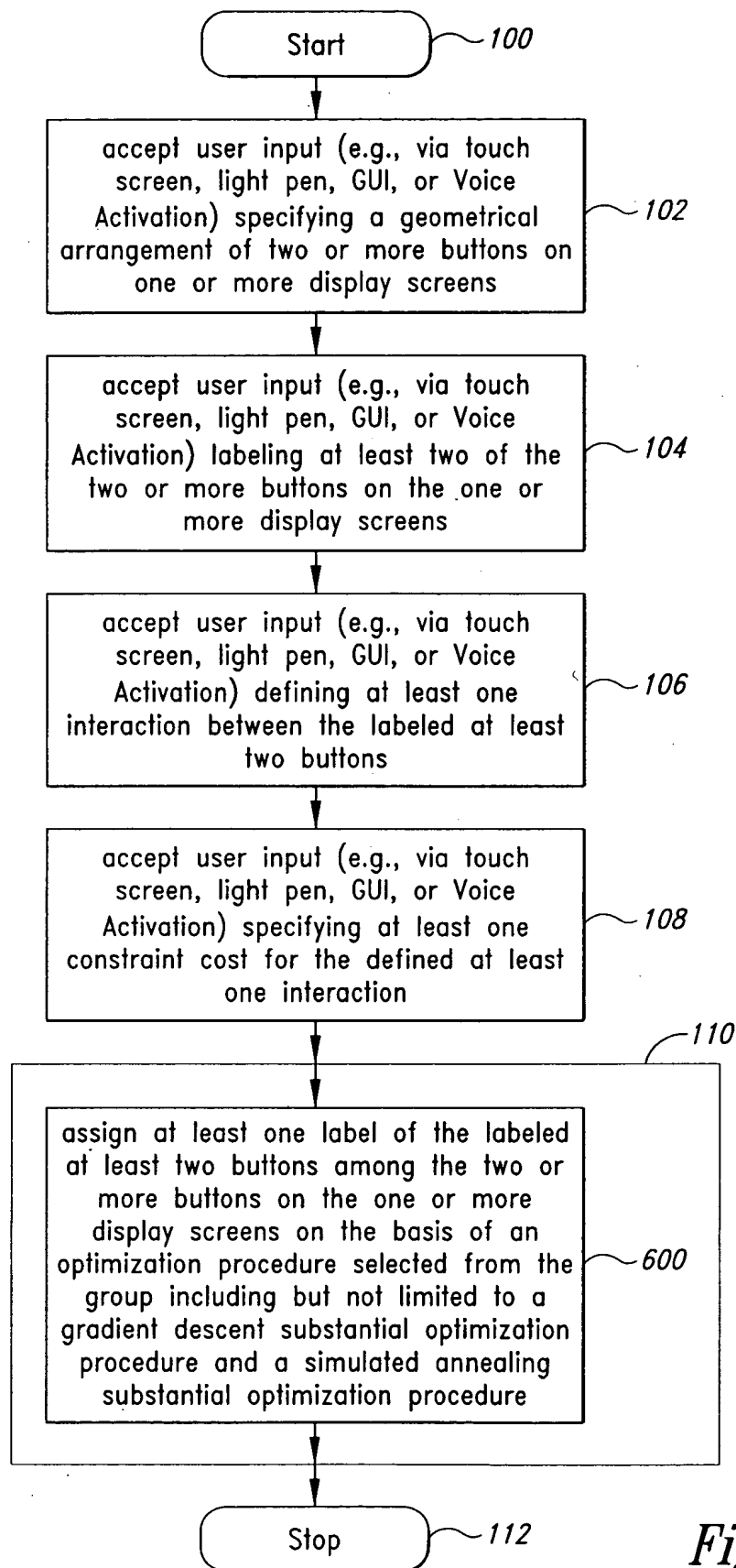


Fig. 3

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*Fig. 4*

*Fig. 5*

*Fig. 6*

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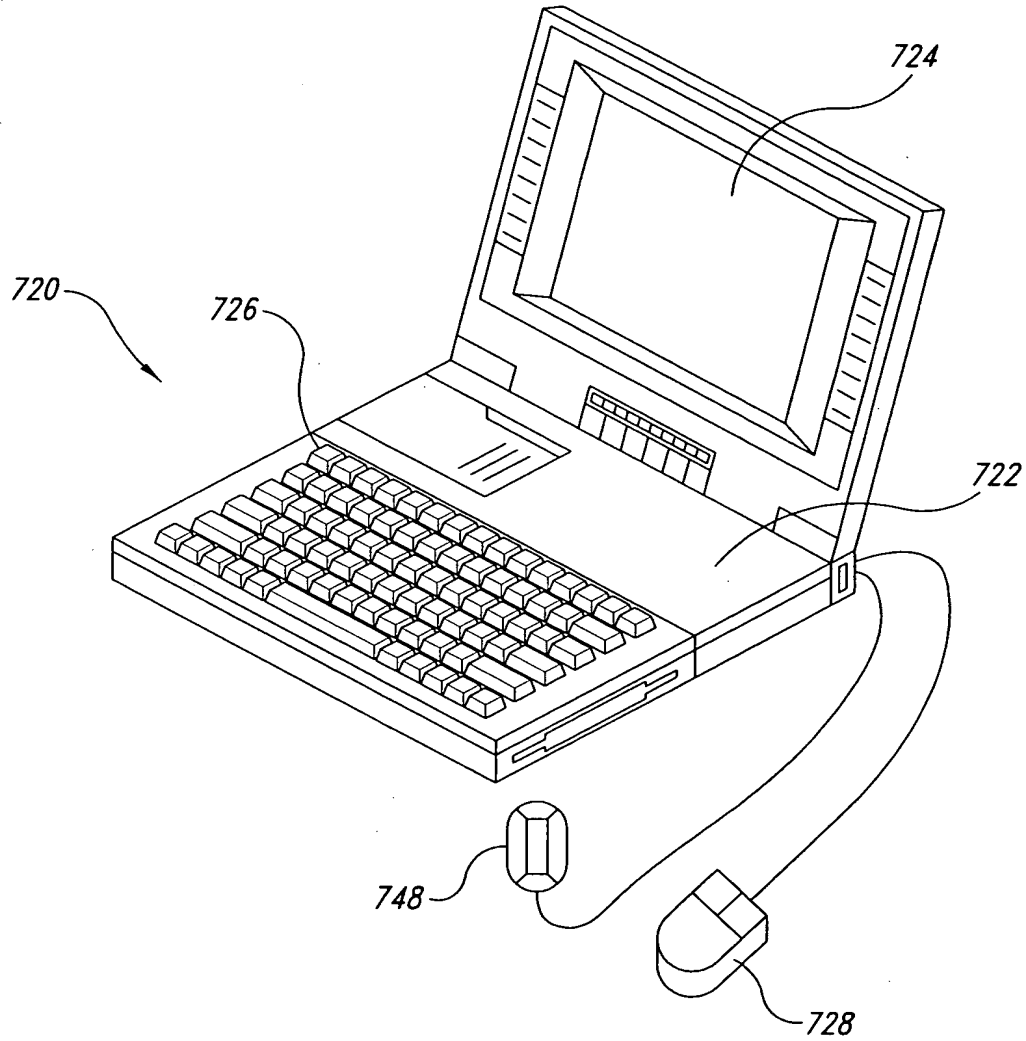


Fig. 7

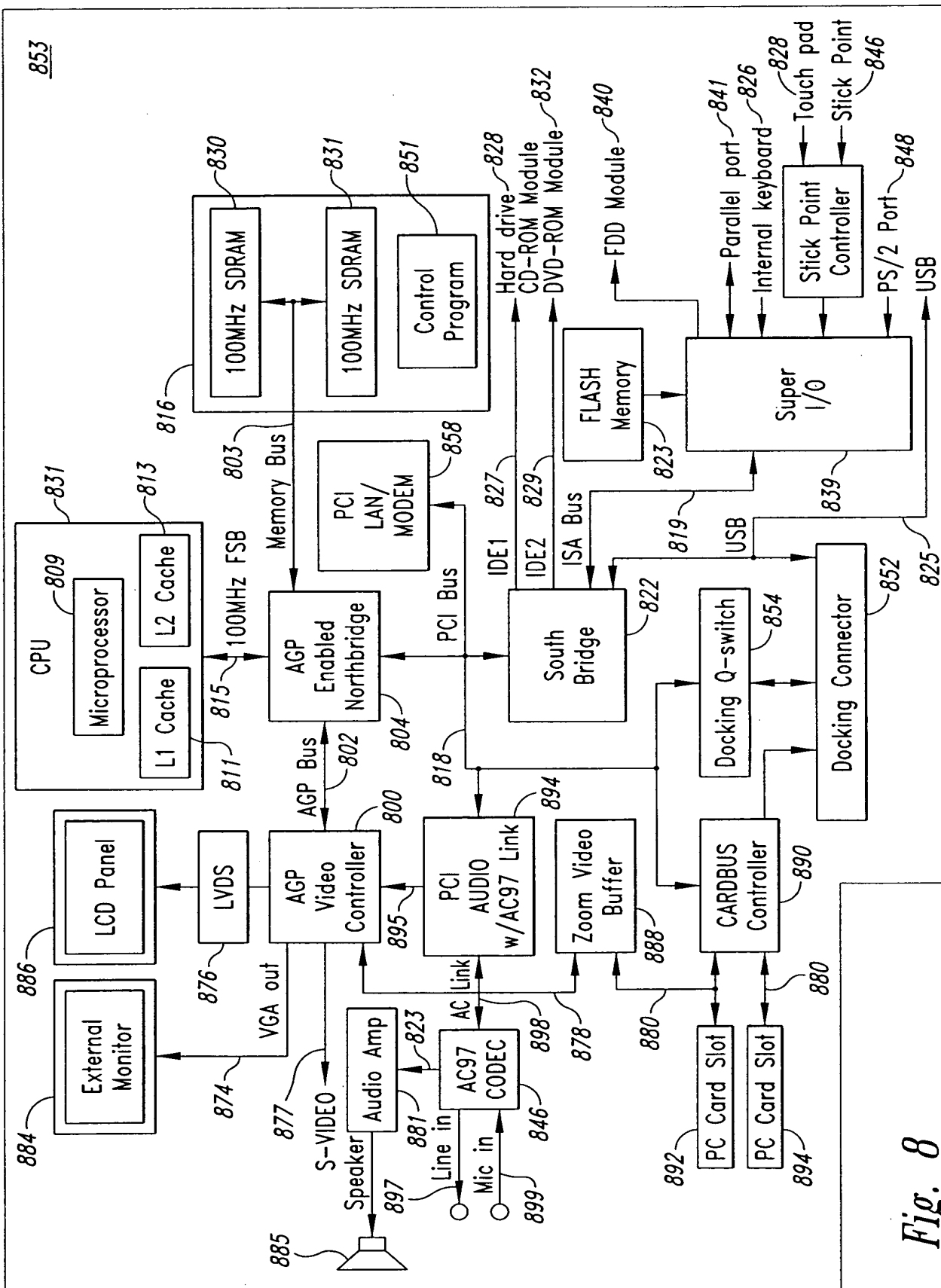
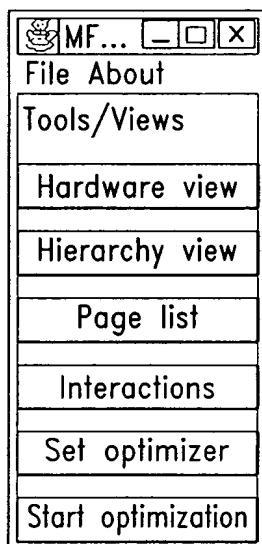


Fig. 8



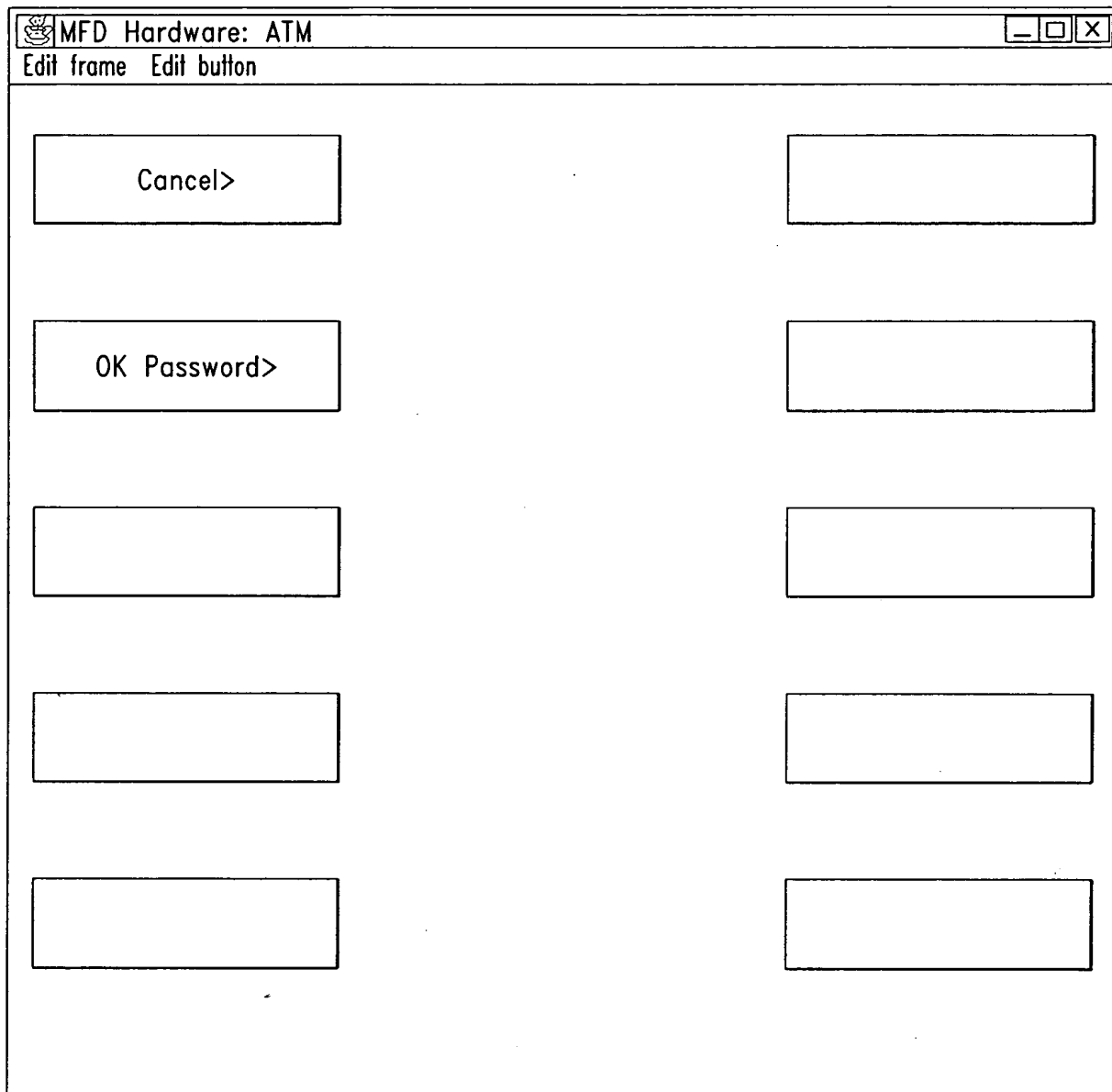
The MFDTool startup window, as seen in Windows 98.

Fig. 9

ATM & Name
 6 6 & xSize, ySize
 %Buttons
 1.5 0.5 0.1 0.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 0.1 1.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 0.1 2.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 0.1 3.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 0.1 4.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 4.4 0.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 4.4 1.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 4.4 2.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 4.4 3.25 & xSize, ySize, xPlace, yPlace
 1.5 0.5 4.4 4.25 & xSize, ySize, xPlace, yPlace
 &&

Contents of the file ATM.hdw, which defines the size of the MFD and the physical properties of the buttons for the ATM example.

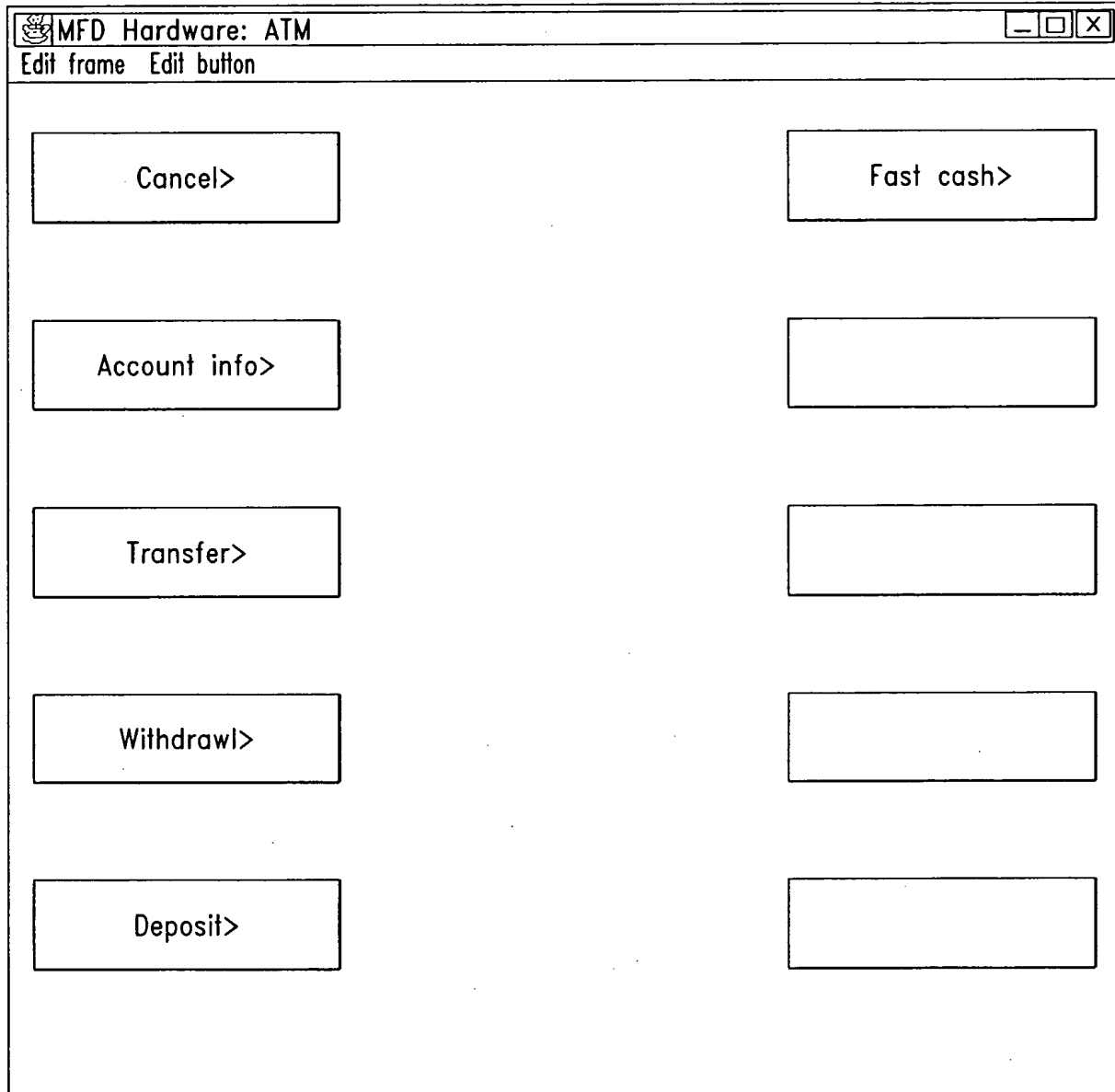
Fig. 10



The MFD Hardware window shows the physical layout of the MFD and its buttons, as specified in the file ATM.hdw.

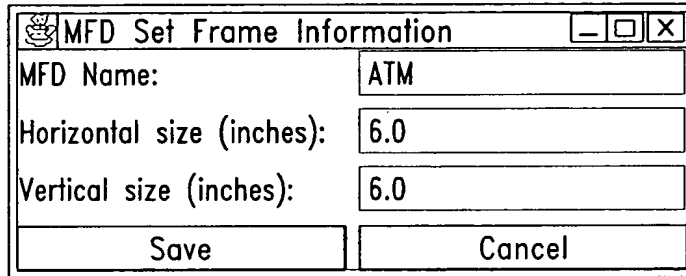
Fig. 11

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The MFD Hardware window after selecting the OK Password label show the labels on the selected page.

Fig. 12

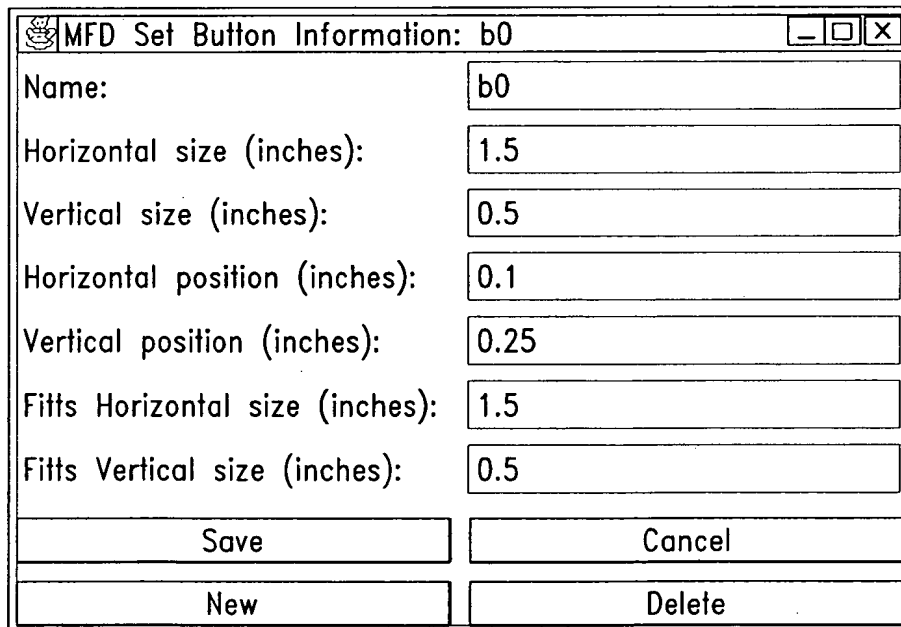


A dialog box titled "MFD Set Frame Information" with a standard Windows icon in the top-left corner and minimize, maximize, and close buttons in the top-right corner. The dialog contains three input fields: "MFD Name:" with the value "ATM", "Horizontal size (inches):" with the value "6.0", and "Vertical size (inches):" with the value "6.0". At the bottom, there are two buttons: "Save" and "Cancel".

MFD Name:	ATM
Horizontal size (inches):	6.0
Vertical size (inches):	6.0
Save	Cancel

The MFD Set Frame Information window allows the designer to modify the name of the MFD and set the size of the MFD frame.

Fig. 13

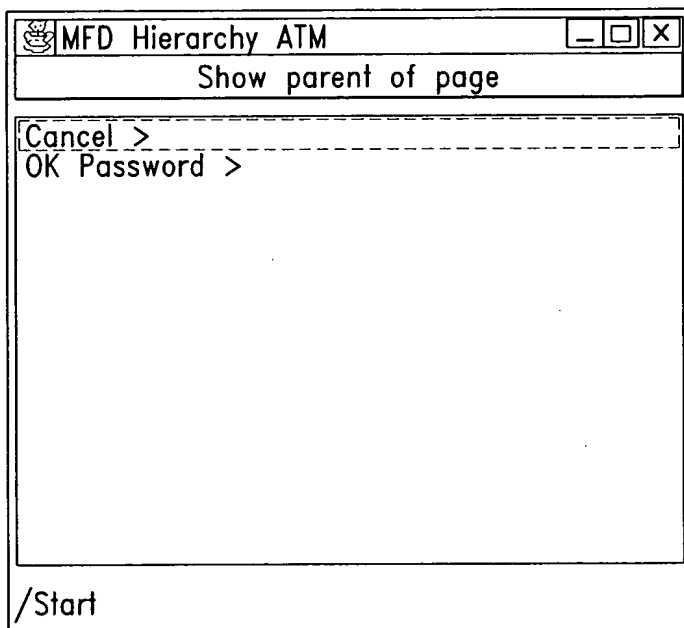


A dialog box titled "MFD Set Button Information: b0" with a standard Windows icon in the top-left corner and minimize, maximize, and close buttons in the top-right corner. The dialog contains seven input fields: "Name:" with the value "b0", "Horizontal size (inches):" with the value "1.5", "Vertical size (inches):" with the value "0.5", "Horizontal position (inches):" with the value "0.1", "Vertical position (inches):" with the value "0.25", "Fitts Horizontal size (inches):" with the value "1.5", and "Fitts Vertical size (inches):" with the value "0.5". At the bottom, there are four buttons: "Save", "Cancel", "New", and "Delete".

Name:	b0
Horizontal size (inches):	1.5
Vertical size (inches):	0.5
Horizontal position (inches):	0.1
Vertical position (inches):	0.25
Fitts Horizontal size (inches):	1.5
Fitts Vertical size (inches):	0.5
Save	Cancel
New	Delete

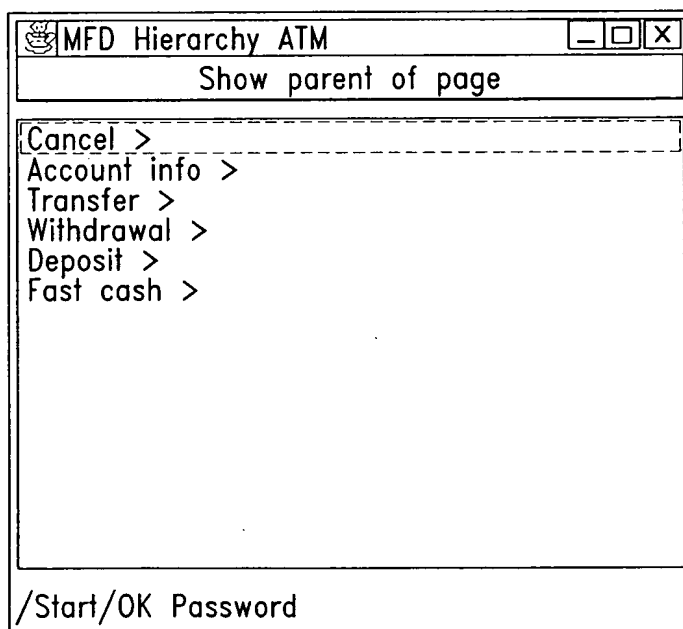
The MFD Set Button Information window allows the designer to modify button properties, delete a button, and create a new button.

Fig. 14



The MFD Hierarchy window as it appears after opening the file ATM.hdw.

Fig. 15



The MFD Hierarchy window as it appears after selecting the page name
OK Password.

Fig. 16

MFD Page list: ATM

Page properties

Button assignment Name:

b0 ☒ Proportion: ☒ Free ☐ Fixed

b1 ☐ Page type: Start

b2 ☐ No hyperlink required

b3 ☐ Swap to clicked button

b4 ☐

Sort page listing by

Name	Page type	Proportion
CheckingToSavings	T	0.023809524
CreditCard	P	0.023809524
Deposit	P	0.023809524
Exit	T	0.023809524
Fast cash	P	0.023809524
Loans	P	0.023809524
Mortgage	T	0.023809524
NewTransaction	H-	0.023809524
OK Password	P	0.023809524
Personal	T	0.023809524
RecentTransactions	T	0.023809524
RecentTransactions	T	0.023809524
RecentTransactions	T	0.023809524
Savings	P	0.023809524
Savings	T	0.023809524
Savings	T	0.023809524
SavingsToChecking	T	0.023809524
Start	P	0.023809524
Transfer	P	0.023809524
Withdrawal	P	0.023809524

The MFD Page list window as it appears after opening the file ATM.hdw.

Fig. 17

MFD Page list: ATM

Page properties

Button assignment: **Name:** **Proportion:** ☒ Free ☐ Fixed

Page type: **Start** **Hyperlink**

Swap to clicked button

Save **Duplicate** **New** **Delete** **Cancel**

Sort page listing by

Name	Page type	Proportion
CheckingToSavings	T	0.023809524
CreditCard	P	0.023809524
Deposit	P	0.023809524
Exit	T	0.023809524
Fast cash	P	0.023809524
Loans	P	0.023809524
Mortgage	T	0.023809524
NewTransaction	H-	0.023809524
OK Password	P	0.023809524
Personal	T	0.023809524
RecentTransactions	T	0.023809524
RecentTransactions	T	0.023809524
RecentTransactions	T	0.023809524
Savings	P	0.023809524
Savings	T	0.023809524
Savings	T	0.023809524
SavingsToChecking	T	0.023809524
Start	P	0.023809524
Transfer	P	0.023809524
Withdrawal	P	0.023809524

The MFD Page list window as it appears after selecting the page name OK Password.

Fig. 18

MFD Page list: ATM

Page properties

Button assignment Name:

Left top ☒ Proportion: ☒ Free ☐ Fixed

Left 2 ☐ Page type:

Left 3 ☐ OK Password

Left 4 ☐ No hyperlink required

Swap to clicked button

Sort page listing by

Name	Page type	Proportion
\$10	T	0.023809524
\$20	T	0.023809524
\$50	T	0.023809524
Account info	P	0.023809524
AccountBalance	T	0.023809524
AccountBalance	T	0.023809524
Balance	T	0.023809524
Cancel	P	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Cancel	H-	0.023809524
Car	T	0.023809524
Checking	P	0.023809524
Checking	T	0.023809524

The MFD Page list window as it appears after selecting the page Cancel.

Fig. 19

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MFD Set Interactions: ATM

Select interaction

Initial interaction

Name

Initial interaction

Delete interaction Duplicate interaction

New interaction Save interaction

Set constraints

Interface coefficients Load pre-defined coefficients Fitts movement

From -- To	Left top	Left 2	Left 3	Left 4
Left top	0.0	0.0	0.0	0.0
Left 2	0.0	0.0	0.0	0.0
Left 3	0.0	0.0	0.0	0.0
Left 4	0.0	0.0	0.0	0.0
Left bottom	0.0	0.0	0.0	0.0
Right top	0.0	0.0	0.0	0.0
Right 2	0.0	0.0	0.0	0.0
Right 3	0.0	0.0	0.0	0.0
Right 4	0.0	0.0	0.0	0.0

Interaction opened

The MFD Set Interactions window as it appears after selecting the Initial interactions.

Fig. 20

0940669-072004

MFD Set Interactions: ATM

Select interaction

Initial interaction

Name

Initial interaction

Delete interaction Duplicate interaction

New interaction Save interaction

Set constraints

Interface coefficients Load pre-defined coefficients Euclidian distance

From -- To	Left top	Left 2	Left 3	Left 4
Left top	0.0	1.0	2.0	3.0
Left 2	1.0	0.0	1.0	2.0
Left 3	2.0	1.0	0.0	1.0
Left 4	3.0	2.0	1.0	0.0
Left bottom	4.0	3.0	2.0	1.0
Right top	4.3	4.414748	4.7423625	5.2430906
Right 2	4.414748	4.3	4.414748	4.7423625
Right 3	4.7423625	4.414748	4.3	4.414748
Right 4	5.2430906	4.7423625	4.414748	4.3

Coefficients updated.

The MFD Set Interactions window as it appears after loading coefficients for
Euclidian distance.

Fig. 21

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MFD Constraints: ATM - Initial interaction

Select constraint

Add a new constraint

Global difficulty

New constraint

Save constraint

Constrained pages

Remove selected page

Add MFD page

Weight

Name

Select constraint

Left top

Left 2

Left 3

Left 4

Left bottom

Right top

Right 2

Add clicked button

Delete constraint

Duplicate constraint

The MFD Constraints: ATM - Initial interaction window when it first appears.

Fig. 22

0910669-072001

MFD Constraints: ATM - Initial interaction

Select constraint Add a new constraint

Global 3.9523809523 Global difficulty

Delete constraint New constraint

Duplicate constraint Save constraint

Select constraint Constrained pages

Left top Remove selected page Add MFD page

Left 2

Left 3

Left 4

Left bottom

Right top

Right 2

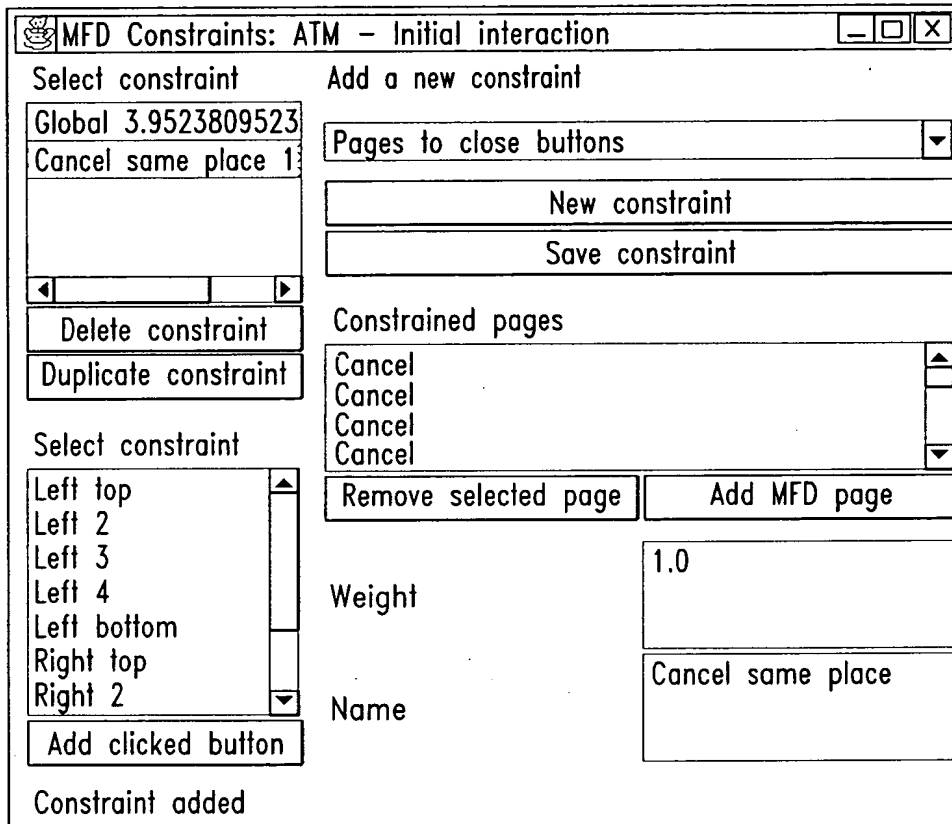
Weight 1.0

Add clicked button Name Global

Constraint added

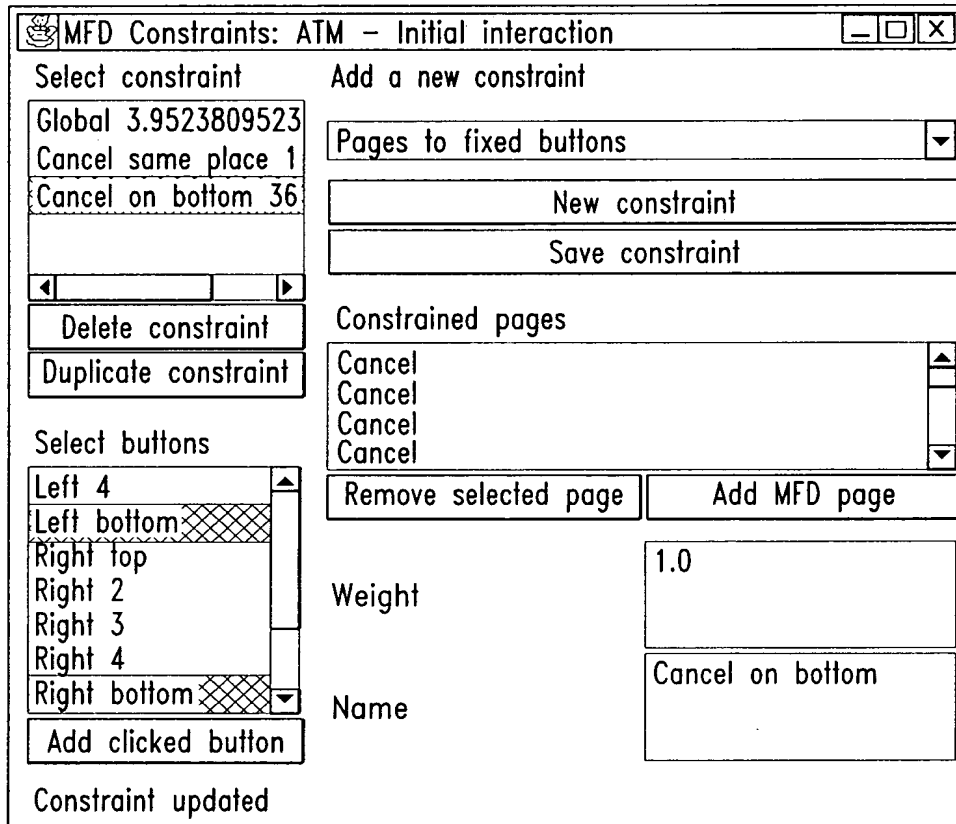
The MFDTool window as it appears after creating and saving the constraint Global.

Fig. 23



The MFD Constraint window as it appears after creating and saving the constraint Cancel same place. The list Constrained pages shows all the pages restricted by this constraint.

Fig. 24



The MFD Constraints window as it appears after creating and saving the constraint Cancel on bottom. The list Constrained pages shows all the pages restricted by this constraint. The list Select buttons shows the buttons that the constrained pages must be restricted to.

Fig. 25

MFD Constraints: ATM - Initial interaction

<p>Select constraint</p> <p>Global 3.9523809523</p> <p>Cancel same place 1</p> <p>Cancel on bottom 36</p> <p>Cancel ->NewTransac</p> <p>◀ ▶</p> <p>Delete constraint</p> <p>Duplicate constraint</p>	<p>Add a new constraint</p> <p>Path difficulty</p> <p>New constraint</p> <p>Save constraint</p>
<p>Select buttons</p> <p>Left 4</p> <p>Left bottom</p> <p>Right top</p> <p>Right 2</p> <p>Right 3</p> <p>Right 4</p> <p>Right bottom</p> <p>Add clicked button</p>	<p>Constrained pages</p> <p>Cancel</p> <p>NewTransaction</p> <p>Remove selected page</p> <p>Add MFD page</p> <p>Weight</p> <p>100.0</p> <p>Name</p> <p>ncel ->NewTransaction</p>

Constraint added

The MFD Constraints window as it appears after creating and saving the constraint Cancel -> New Transaction. The list Constrained pages shows the path of pages restricted by this constraint. In this case, the path starts at the Cancel hyperlink under Fast cash and goes to the New Transaction page under the Cancel page near the top of the hierarchy. MFDTool will assign page labels to buttons so that the sum of interaction coefficients is minimized along this path of pages.

Fig. 26

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MFD Constraints: ATM - Initial interaction

Select constraint

Cancel same place

Cancel on bottom

Cancel ->NewTrans

Cancel on bottom 36

Delete constraint

Duplicate constraint

Select buttons

Left 4

Left bottom

Right top

Right 2

Right 3

Right 4

Right bottom

Add clicked button

Constraint added

Add a new constraint

Parent to child variability

New constraint

Save constraint

Constrained pages

Checking

Checking

Checking

Remove selected page

Add MFD page

Weight

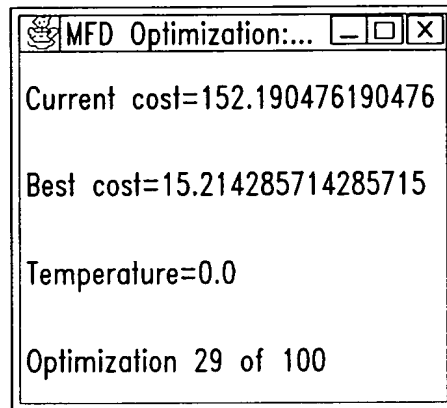
100

Name

Checking variance

The MFD Constraints window as it appears after creating and saving the constraint Checking variance. The list of Constrained pages shows all the pages restricted by this constraint.

Fig. 27



The MFD Optimization window as it appears while running an optimization.

Fig. 28

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100270 69681US

00010669.072001

MFD Constraints: ATM - Initial interaction

Select constraint

Global 2.8571428571428563
Cancel same place 0.0
Cancel on bottom 0.0
Cancel ->NewTransaction 0.0
Checking variance 0.0

Delete constraint
Duplicate constraint

Select buttons

Left top
Left 2
Left 3
Left 4
Left bottom
Right top
Right 2

Add clicked button

Add a new constraint

Global difficulty

New constraint
Save constraint

Constrained pages

Remove selected page Add MFD page

Weight

Name

The MFD Constraints window as it appears after the optimization. The cost for all but the Global is zero, indicating that these constraints are perfectly satisfied.

Fig. 29

MFD Set Button Information: b0		File	
Number of optimizer		<input checked="" type="radio"/> Gradient descent	<input type="radio"/> Simulated annealing
Number of swaps per cycle:		300	
Number of initialization cycles (bigger is more random):		200	
Number of cycles unchanged before checking on local minimum:		10	
Number of random restarts of gradient descent:		200	
Simulated annealing start temperature:		0.0	
Simulated annealing temperature multiplier ($0 < x < 1$):		0.990000009537432	
Save parameters			

The MFD Set Optimizer window.

Fig. 30